More Centripetal Force

1. A children’s merry-go-round has two children on it. One child is twice as heavy as the other child. The two children spin the merry-go-round and hold on. How much harder does the heavy child have to hold on?
2. The two children get bored of using the merry-go-round at speed v. They decide to double the speed. How much harder to they have to hold on at twice the speed?
3. A second merry-go-round is twice the radius (diameter, circumference) of the first merry-go-round. They spin it at the same speed v as before. How much harder do they have to hold on?
4. Given the information above, explain what you should do if you are driving and have to make a hard turn.
5. A 60kg woman stands at rest on a scale. Draw the FBD for the woman, and calculate all forces on her.
6. A more detailed look at the previous question reveals that the forces on the woman are not balanced. The Earth is spinning, and so there is a small non-zero centripetal force acting on her. Assuming the woman is at the Equator, find:
7. The speed of the woman, in m/s
8. The net force on the woman (i.e. the centripetal force)
9. The apparent weight of the woman – use proper vector notation with Fnet = ma. Does the spinning of the earth make the woman feel lighter or heavier than her actual weight?
10. In a game of miniputt, a 150g golfball must go around a frictionless semicircular bank of radius 80cm in order to get to the hole as shown. The bank is angled at 40o. What is the minimum speed that the ball must have to stay in the middle of the bank all the way around?

sdFront View

Side View

sdTop View

1. A 400kg car is traveling at 100km/h (27.7m/s) on an icy (i.e. frictionless) road when it reaches a turn in the road. The turn is of radius 35m. How steep of an angle must the road be banked in order to keep the car in the centre of the road?
2. A car of mass 400kg is traveling on a road with frictional coefficient 0.48. The road is banked at a 15o angle. What is the maximum speed the car can go without flying off?
3. A skateboarder of mass 80kg rides around a track that is banked steeply at both ends. The banks form a semicircle of radius 5.7m and steepness of 65o. The skateboard has a frictional coefficient of 0.35 when skidding (ex. sliding sideways). What is the minimum speed needed by the skateboarder to get around the turn without falling down the steep bank?
4. At the Highland Games, a 10kg mass attached to a 80cm chain is thrown by a spinning athlete. If the athlete’s arms are 60cm long (arm and chain are colinear) and he spins at a rate of 0.8 rotations per second, find the tension in his arm and the angle of the arm/chain as he spins.
5. A 100g slab of mud has a sticking force of 75N onto my truck tire. The tires have a radius of 30cm. How fast can my wheels spin without spraying mud everywhere?
6. A toy has a string with a weight attached at each end. The string passes through a tube as shown. The top weight is whirled around in a horizontal circle while the bottom weight hangs at rest. How fast must the person whirl the upper weight (in rotations per second) when the rotating part of the string is 10cm long?

25g

25g

40g

1. A jet plane has many forces acting on it. Consider two forces only: **lift**, which acts normal to the wings, and **gravity**, which acts in a downward direction. Use a FBD (no calculations) to show that when a pilot tilts the plane while keeping the lift force at a constant magnitude, two things will happen: the plane will turn, and it will fall. In particular, show that the more the plane tilts, the harder it will turn and the faster it will fall. How does a pilot tilt and turn a plane without falling?